UNIT 15 - COLOR TEMPERATURE OF STARS

Introduction

Although the stars appear to the naked eye to be white (with only a few exceptions), when photographed they are in fact shown to be colored. Some stars appear to be red, others (such as our own Sun) to be yellow, some white, and some blue. The precise color of a star is determined by the balance of the different colors of light the star emits from its surface, which is in turn dependent on its surface temperature. The coolest stars emit primarily red light, and so appear red. With increasing temperature, an increasing proportion of light of shorter wavelength is emitted, to the point where the very hottest stars have a preponderance of blue light.

By studying the light given off by a star, we can determine its surface temperature. In order to do so, the light arriving from the star must first be split up into its different colors, or different wavelengths. The piece of scientific apparatus which accomplishes this is known as a *spectroscope*. Once the light is broken down into its different wavelengths, the relative intensity for each wavelength can be measured. Wien's Law then relates the wavelength at which the intensity reaches a maximum and the surface temperature of the star:

$$\text{Surface Temperature} = 2.898 \times 10^6 / \text{Peak Wavelength}$$

where the peak wavelength is measured in nanometers (nm), and the temperature is measured in Kelvin (K)[1].

For example, our Sun has a peak wavelength of about 480 nm. Our Sun therefore has a surface temperature calculated as:

$$\text{Surface Temperature} = 2.898 \times 10^6 / 480 = 6000 \text{ K}$$

or about 5800 ^{o}C.

Experiment

1. Select *Color Temperature of Stars* from the *Start Lab* menu. The view shows a portion of the sky containing 50 stars, with a range of surface temperatures. The stars are shown as colored, with the hottest stars being blue and the coolest stars red. By selecting *Number of Stars* from the overhead menu, you may change the number of stars which appear in the window.

2. Click on any star in order to view that star's distribution of light amongst the different visible wavelengths. (Click anywhere in this window in order to be returned to the view of the stars.)

---

[1] Kelvin is the scientific unit of temperature, defined so that the lowest possible temperature (absolute zero) corresponds to a temperature of zero.

3. For each star, measure the wavelength at which the peak light intensity occurs. To assist you in reading the plot, the display at the bottom of the screen shows the wavelength (in nm) at the position of the cursor. Make sure that you record the number of the star.

4. Use Wien's Law to calculate the surface temperature of the star.

5. Select *Check Your Results* from the overhead menu. Enter the identification number for the star, the wavelength (in nm) at which the light intensity is a maximum, and the surface temperature. Correct results will be indicated with a check mark.

6. Repeat the above steps for as many stars as you like.